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Perspective

Fibrinolytic Alveolitis, since 1896: *Contemporary Concepts and Quandaries.*

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Précis - During basic and specialized training, we're often told that socket preservation is standard of care. Today, we wonder, is it? If not, why not? We were also voiced much about atraumatic extraction and the simple technique of socket grafting, especially in areas where bone and soft tissue shrinkage would impede proper pontic aesthetics and implant placement. What about retained roots, trauma to other structures, damage to developing (underlying) permanent teeth, and need for tension-less flaps at suture line? Are dentists following? Do we in the smile zone, at least? Besides, why are we still questioned, almost on a regular basis, by residents as well as fellow clinicians whether to irrigate or not, post-extraction? Concerns, we thought to address celebrating the end of 2017, or in better words, ~120 years since coining the term "dry socket" for the first time.

Whether an infection, a single tooth extraction, impacted third molar, or a biopsy, dentists usually encounter aspects of oral surgery in day-to-day practice. Indeed, *exodontia* is one of the most common dental procedures (and perhaps "most rationale" treatment option, whether we admit it or not).[1] Anyhow, the resulting extraction socket, generally, heals uneventfully; where a properly formed fibrin clot undergoes organization, vascularization and gradual replacement with bone through an osteo-proliferation process (so, there is a need to allow for and support proliferation of fibroblasts and epithelialization, post-extraction. *Do we all consider?*).[1,2] Now, due to caries, periodontal disease or trauma, exodontia will result in osseous deformities/resorption of the alveolar bone ridges: loss of vertical height/width, resulting in a narrower/shorter ridge; consequently, deformation of facial aesthetics; especially anteriorly. After tooth removal, the dental team faces the challenge of creating a prosthetic restoration that blends with adjacent natural dentition; often requiring secondary surgeries and use of barrier membranes, bone grafts and/or grafting substitutes, preceding to the prosthesis delivery.[1]

Evidently, the less we know about a condition, the more we give it names for a closer description. Undeniably, whether alveolar osteitis, alveoloalgia, alveolitis sicca dolorosa, avascular socket, localized osteitis, localized acute alveolar osteomyelitis or fibrinolytic alveolitis, referred to simply as "dry socket" (a term first used by Crawford in 1896),[3] remains amongst the most commonly encountered complication following routine extraction or even the surgical removal of teeth by general dentists as well as specialists.[1]

The most recent definition of dry socket describes the condition as post-operative pain inside and around the extraction site, increasing in severity at

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any time between the 1st /2nd and 3rd/4th day post-extraction, alongside partial or total disintegration (pre-mature dislodgment) of the blood clot within the alveolar socket (due to an increased fibrinolytic activity or fibrinolysis that destroys the blood clot early). Development of dry socket leads to excruciating pain, foul breath/halitosis, unpleasant taste, empty socket (socket containing necrotic debris and shed bone), gingival inflammation and lymphadenopathy.[4]

While the exact pathogenesis of dry socket is not well understood rendering no possible treatment, incidence is mainly attributed to difficulty of extraction procedure (*i.e.*, trauma), lack of experience, smoking, bacterial infection/poor oral hygiene, and/or association with systemic conditions including: cardiovascular/liver disease, diabetes, anemia/blood dyscrasias, vitamin-/nutritional deficiencies).[2,4] Yet, we do face dry sockets in systemic disease-free patients. Agreed? Thus, more detrimental to the development of dry sockets are the local factors: surgical trauma (promotes release of tissue activators converting plasminogen to plasmin thereby easing clot lysis and the formation of kinins, a main cause of reported intense pain), uncontrolled infections (pre-/post-operative; peri-coronal or peri-apical root tip infections, for instance?), insufficient blood supply to the alveolus or excessive vaso-constriction due to hemostatic agents and 'excessive' alveolus irrigation.[5]

Condition *f*requency; a constant surge; for routine extractions (5%-25%), post-extraction of third molars (40%-55%), surgical extractions result in ~10 times higher incidence.[1,4,6]

Can it be safely assumed that a vast majority of cases remain un-diagnosed as the problem tends to occur days post-operatively, and may not be reported or recognized?

Given that dry socket remains the most common and often self-limiting post-extraction process and complication, various pre-/post-operative attempts have been invested seeking a successful method for prevention, management and/or treatment, including primary *versus* secondary socket closure, prescription of topical and systemic antibiotics, chlorhexidine (0.12%) mouth-wash and intra-socket chemotherapeutic agents and steroids. However, this area remains a controversial topic as no single method has gained Universal acceptance.[7-9] To re-emphasize, contamination of the extraction socket and site, whether with or even without presence of a gross infection, do contribute to the development of a dry socket. Indeed, bacteria (certain strains of hemolytic *streptococci*) may lead to dry socket via inducing the chemical disruption and premature *in situ* lysis of the blood clot while other strains (*streptococci viridans*) may fully impede clot formation.[2,7]

Therefore, careful follow-up and management via pain control using local and systemic analgesics and antibiotics until the commencement of normal (highly rare) healing is the recommended practice or 'gold standard' today.[7,8] Now, schools of thought do vary. Some oral surgeons prefer to use absorbable or dressings as a scaffold to pack the extraction socket, support and stabilize the blood clot. Other surgeons, to whom we belong, prefer a healthy blood clot and only the clot without any foreign bodies introduced within the socket. The rationale behind it is linked to risk of an infected alveolus; further complicating the condition via the introduction of a foreign substance; simplifying a persistent infection. Such dressings are only to be used in very clean extraction sockets and surgical sites. Now, whether you apply a dressing or not, it is recommended to always close the site with sutures, in order to protect and hold the new blood clot *in situ* as well as prevent any contamination of the alveolus from bacteria and food debris.[7-9] Remember, the goal is to allow and facilitate natural socket bleeding via re-establishing a favorable environment conductive for normal and accepted osseous healing of the extraction socket. *Would you consider a daily change and/or replacement of dressing necessary for good prognosis?*

The development and use of intra-alveolar dressing materials has been widely suggested in the literature, in combination with different medicaments (anesthetics, analgesics and antimicrobials). Alveogyl (Septodent, Inc.), commercially-available for years, is a fine example. Little scientific evidence supports its success considering clinicians and researchers reporting recurrent retardation of healing and inflammation (delayed healing leading to additional complications and negative prognosis of alveolar osteitis resulting in severe alveolar bone resorption/loss) for sockets packed with Alveogyl. Thus, *not* recommending its clinical use. Other materials, including: calcium phosphate/hydroxyapatite, borosilicate, chitosan/gelatin; are proposed based on the ability to promote bone healing; still, an 'ideal' bone graft material is not yet identified.[6-10]

Tissue engineering aims to replace/facilitate the re-growth of damaged/diseased tissue mainly via applying a combination of biomaterials, cells and bioactive molecules. Biodegradable polymeric scaffolds have received much attention as they provide a tempora-spatial environment for localized cellular and tissue in-growth:

(1) a classic 3-D porous matrix (implantable); highly-porous and inter-connected structure allowing high cell-seeding density and tissue in-growth; (2) a nano-fibrous matrix (implantable) prepared by electrospinning or self-assembly providing a better resemblance of physiological environment; (3) a thermosensitive sol-gel transition hydrogel (injectable); and (4) a porous microsphere (injectable).

These are already widely utilized as sustained protein-release formulations and have been applied in bone regeneration as cell delivery carriers or supportive matrices.[8,10] Of those, porous nanospheres incorporated within an injectable thermo-responsive hydrogel, are thrilling; an ongoing R&D&i topic at BioMAT'X.

Despite ample investigations and attempts in preventing or treating dry socket, it is noticed that dentists continue to question the effect of "lavage" or a sterile saline irrigation step at the end of the extraction procedure and/or how it would affect the extraction site(s) and post-extraction socket healing; especially in terms of development of alveolar osteitis.

To cut the long story short, and to best of knowledge, lavage or irrigation with a sterile normal saline solution delivered usually by a hand monoject syringe seems to play a major role in washing away/removing the *in situ* fresh blood thereby decreasing intra-socket bleeding and leaving it empty (or full of saline – not blood); particularly attributed to negligent volume, temperature and pressure. Some studies suggest a less need for immediate post-extraction lavage; however, others report the effect of irrigation volume in reducing the incidence of dry socket;[8] thereby fueling this seemingly ongoing dilemma. Yet, it can be concluded and stated, collectively, that immediate post- extraction irrigation of a fresh socket commonly performed in part of the surgical exodontia technique is a direct contributing factor to the development of localized dry socket, hence, well to avoid.

Best management scheme to-date is anticipating and preventing the development of this condition/complication via patient education and early identification of risk factors. Otherwise, slowly irrigate with a small and slightly-warm volume of sterile saline. Debridement (ensuring no necrotic/infected tissue left), curettage (re-starts bleeding from socket lining), lightly packing the socket or surgical site with an obtundent dressing and tension-free flap/suture closure (gingiva:alveolus) is recommended herein, typically, under anesthesia. Prescribe antibiotics and re-assess within 24 hours. Practice caution.

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